Second Graders to the Rescue!

Brief Overview:

This unit focuses on basic shapes and symmetry. Students will construct symmetrical and nonsymmetrical designs with cubes and pattern blocks and explain why a particular design does or does not show symmetry.

NCTM 2000 Principles for School Mathematics:

- **Equity:** *Excellence in mathematics education requires equity - high expectations and strong support for all students.*
- **Curriculum:** *A curriculum is more than a collection of activities: it must be coherent, focused on important mathematics, and well articulated across the grades.*
- **Teaching:** *Effective mathematics teaching requires understanding what students know and need to learn and then challenging and supporting them to learn it well.*
- **Learning:** *Students must learn mathematics with understanding, actively building new knowledge from experience and prior knowledge.*
- **Assessment:** *Assessment should support the learning of important mathematics and furnish useful information to both teachers and students.*
- **Technology:** *Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning.*

Links to NCTM 2000 Standards:

- **Content Standards**

Algebra

- *Understand patterns, relations, and functions; and represent and analyze patterns and functions, using words, tables, and graphs.*

Geometry

- *Analyze characteristics and properties of two-and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships; identify, compare, and analyze attributes of two- and three-dimensional shapes and develop vocabulary to describe the attributes; classify two-and three-dimensional shapes according to their properties and develop definitions of classes of shapes such as triangles and pyramids; investigate, describe, and reason about the results of subdividing, combining, and transforming shapes; explore congruence and similarity; and make and test conjectures about geometric properties and relationships and develop logical arguments to justify conclusions.*
- *Specify locations and describe spatial relationships using coordinate geometry and other representational systems; describe location and movement using common language and*

geometric vocabulary; make and use coordinate systems to specify locations and to describe paths; and find the distance between points along horizontal and vertical lines of a coordinate system.

- *Apply transformations and use symmetry to analyze mathematical situations; predict and describe the results of sliding, flipping, and turning two-dimensional shapes; describe a motion or a series of motions that will show that two shapes are congruent; and identify and describe line and rotational symmetry in two- and three- dimensional shapes and designs.*
- *Use visualizations, spatial reasoning, and geometric modeling to solve problems; build and draw geometric objects; create and describe mental images of objects, patterns, and paths; identify and build a three-dimensional object from two-dimensional presentations of that object; identify an draw a two-dimensional representation of a three-dimensional objects; use geometric models to solve problems in other areas of mathematics, such as number and measurement; and recognize geometric ideas and relationships and apply them to other disciplines and to problems that arise in the classroom or in everyday life.*

Measurement

- *Understand measurable attributes of objects and the units, systems, and processes of measurement; understand such attributes as length, area, weight, volume, and size of angle and select the appropriate type of unit for measuring each attribute; understand the need for measuring with standard units and become familiar with standard units in the customary and metric systems; carry out simple unit conversions, such as from centimeters to meters, within a system of measurement; understand that measurements are approximate and how differences in units affect precision; and explore what happens to measurements of a two-dimensional shape such as its perimeter and area when the shape is changed in some way.*

- **Process Standards**

Problem Solving

- *Instructional programs from pre-kindergarten through grade 12 should enable all students to build new mathematical knowledge through problem solving; solve problems that arise in mathematics and in other contexts; apply and adapt a variety of appropriate strategies to solve problems; and monitor and reflect on the process of mathematical problem solving.*

Reasoning and Proof

- *Instructional programs from pre-kindergarten through grade 12 should enable all students to recognize reasoning and proof as fundamental aspects of mathematics; make and investigate mathematical conjectures; develop and evaluate mathematical arguments and proofs; and select and use various types of reasoning and methods of proof.*

Communication

- *Instructional programs from pre-kindergarten through grade 12 should enable all students to organize and consolidate their mathematical thinking through communication; communicate their mathematical thinking coherently and clearly to peers, teachers, and others; analyze and evaluate the mathematical thinking and strategies of others; and the language of mathematics to express mathematical ideas precisely.*

Connections

- *Instructional programs from pre-kindergarten through grade 12 should enable all students to recognize and use connections among mathematical ideas; understand how mathematical ideas interconnect and build on one another to produce a coherent whole; and recognize and apply mathematics in context outside of mathematics.*

Representation

- *Instructional programs from pre-kindergarten through grade 12 should enable all students to create and use representations to organize, record, and communicate mathematical ideas; select, apply, and translate among mathematical representations to solve problems; and use representations to model and interpret physical, social, and mathematical phenomena.*

Grade/Level:

Grade 2

Duration/Length:

Four sixty-minute periods

Prerequisite Knowledge:

Students should have working knowledge of the following skills:

- Identifying attributes of basic shapes
- Combining and partitioning shapes
- Identifying congruent shapes
- Writing to inform

Student Outcomes:

Students will be able to:

- Identify, complete, and create symmetrical designs
- Identify and create nonsymmetrical designs
- Explain orally and in writing why a design is symmetrical or nonsymmetrical

Materials/Resources/Printed Materials:

- Student Resource Sheets # 1-10
- Teacher Resource Sheets # 1-4
- Pencils
- Snap cubes
- Overhead projector

- Overhead snap cubes
- Overhead markers
- Transparencies
- Crayons
- Pattern blocks
- Overhead pattern blocks
- Small basket or container
- Math journals
- Drawing paper
- Writing Paper
- Construction paper
- Scissors
- Glue
- Hole Puncher
- Binder rings or access to a binding machine

Development/Procedures:

Day One

- Share the letter from the first graders (see Teacher Resource Sheet # 1) with the class. Discuss what students need to learn to help the first grade students.
- Show students a snap cube train with 3 cubes of one color connected to 3 cubes of another color. Ask students to describe the cube train and its two parts. Introduce the term symmetry to describe the cube train, a shape whose halves are mirror images of each other. Break the cube train in the center and line up the two halves so that one color covers another color to show students that the two parts are congruent. Introduce the term, line of symmetry, to describe where a shape is broken in half to show its two congruent parts. Review these terms using cube trains of different lengths (4, 10, etc.).
- Give each student several snap cubes. (If possible, make sure that each student has only two colors to help them see the symmetry better.) Using overhead snap cubes of one color, build half of a cube design on the overhead projector and have the students copy it using one color. Challenge students to complete the design by adding the symmetrical part in a different color. When most students have completed their designs, have one student come to the overhead projector and show and explain his/her solution. Repeat the student challenge several times using different designs, always inviting a student to show and explain his/her solution on the overhead.
- Introduce “Cube Connections” (Student Resource Sheet # 1). Have student pairs work together to complete the sheet using their cubes. Pairs who finish early may create their own symmetrical designs using snap cubes and may record them on “Build Your Own Cube Connection” (Student Resource Sheet # 2). Check student work on “Cube Connections” by having students use the overhead snap cubes to show their solutions to each design on the overhead projector.

Day Two

- Show students the hexagon, rhombus, trapezoid, and triangle pattern blocks. Have students briefly describe each shape's attributes. Secretly place one of the pattern blocks into a small container or basket that students cannot see through. Have students take turns feeling the shape inside of the container and sharing information about what they felt with the class. Challenge students to identify the shape based on their classmates' information about what was felt. Once students have agreed on a shape, show them what was in the container. You may repeat this guessing game with each of the pattern blocks previously presented to the students.
- Briefly review symmetry/lines of symmetry as introduced on day one. Give each student several hexagon, rhombus, trapezoid, and triangle pattern blocks. Following the same format as with the cubes on day one, create a design on the overhead projector using overhead pattern blocks and have the students copy it using their pattern blocks. Challenge students to complete the design by adding the symmetrical part. When most students have completed their designs, invite a student to show and explain his/her solution on the overhead using the overhead pattern blocks. Repeat the student challenge several times using different designs, always inviting a student to show and explain his/her solution on the overhead.
- Introduce the "Pattern Partners" challenge (Student Resource Sheet # 3). In this task, students will work in pairs and need to be seated next to their partner. Instruct each student to create a design on half of his/her worksheet with pattern blocks. Then, have students trade seats with their partners and complete their partner's design by adding the symmetrical part using the pattern blocks. Students should then return to their original seats, check their partner's work, and record the entire design completed by their partners by tracing and coloring the pattern blocks used. Early finishers may create more designs for their partners to complete by adding the symmetrical part. If time permits, allow partners to share their designs.
- Discuss strategies students used to complete their partner's design. Assign the following math journal prompt: *In your journal, use math words and pictures to explain what you did to complete your partner's design so that it was symmetrical.* Allow students to share journal responses as time permits.

Day Three

- Briefly review previous days' topic/terms by playing "Thumbs Up, Thumbs Down." Using the overhead projector and overhead pattern blocks, create several symmetrical and nonsymmetrical designs. Have students give you a thumbs-up signal if you indicate a design that shows symmetry and a thumbs-down signal if you indicate a design that does not show symmetry. Have students explain their reasoning for their thumbs up/thumbs down signals for each design.
- Review the letter from the first graders from day one (Teacher Resource Sheet # 1). Present the "Second Graders to the Rescue" task using Student Resource Sheet # 4. Place the "Thumbs Up/Thumbs Down" cards (Teacher Resource Sheet # 2) in small basket or container. Have each student choose a card. Remind students that if they

choose a "Thumbs Up" card, they will be creating and explaining a symmetrical design for the book, and if they choose a "Thumbs Down" card, they will be creating and explaining a nonsymmetrical design for the book. Give each student a copy of the "Book Pages Scoring Rubric" for this task (Student Resource Sheet # 5). Discuss the rubric in detail with the students.

- Instruct students to sit with a partner for the design creation and writing activity. Give the students pattern blocks to use to create their design on "My Design Practice Sheet" (Student Resource Sheet # 6). When students have completed their design, instruct them to have their partners check their design to be sure it matches the appropriate "Thumbs Up/Thumbs Down" card, and then transfer and record their design on drawing paper by tracing and coloring the pattern blocks they used.
- Give students writing paper. Remind them of the criteria for the explanation presented in the rubric. Instruct students to draft their explanation of why their design does or does not show symmetry. Invite a student to briefly summarize the day's learning activities. Inform them that they will finish and present their book pages tomorrow.

Day Four

- Review the "Second Graders to the Rescue" task (Student Resource Sheet # 4) and scoring rubric (Student Resource Sheet # 5) begun on day three. Have students sit with their partners from day three. Instruct students to reread their explanations drafted on day three and make any changes they see necessary. Present the "Peer Response Form" (Student Resource Sheet # 7) and model how to use it to review another person's design and explanation. Instruct students to read their partners' explanations and complete the "Peer Response Form." Students should then use their partner's response form to make any necessary changes to their explanations. Once these changes are made, students should recopy their explanations onto lined writing paper for the class book (Student Resource Sheet # 8/9).

  Note: Student Resource Sheets # 8/9 need to be copied front to back to create a two-sided sheet. The lines should be at the top of one side and the question should be at the bottom of the other side. Instruct students to begin writing their explanations on the line next to the shape icon. More information on using this sheet to assemble the class book is presented in Teacher Resource Sheet # 3.

- When students have completed their responses, model how to horizontally fold Student Resource Sheets # 8/9 in half so that the lines are on the bottom inside and the question *Does this design show symmetry?* is on the front of the folded overflap. Early finishers may complete the extension activities noted below.
- Review characteristics of a good oral presentation. Model the procedure for students to use to give their presentations. (They should show their designs and ask the class, "Does this design show symmetry?" Once classmates have had a chance to respond, students should answer the question themselves by reading their explanation to the class.) Allow time for all students to present their designs and time for feedback from other students and the teacher in between each presentation.

- Compile the students' designs and explanations into a class book. (See Teacher Resource Sheet # 3 for book compilation directions.) Present the class book to a first grade class at your school.

Performance Assessment:

- Use the "Student Learning Checklist" (Teacher Resource Sheet # 4) to record teacher observations of students work, journals, and/or interviews with students on days one and two of the unit.
- Use the "Book Pages Scoring Rubric" (Student Resource Sheet # 5) to assess students' designs and explanations for the class book. The class book is created on days three and four of the unit as part of the performance task "Second Graders to the Rescue" (Student Resource Sheet # 4).

Extension/Follow Up:

- Students may use rubber bands to make the letters in their name on a geoboard to determine what letters in their names have symmetry. Students could record the symmetrical letters and their lines of symmetry on dot paper (Student Resource Sheet # 10).
- Students may go on a "Symmetry Scavenger Hunt" (Student Resource Sheet # 11) to find objects around the school, at home, or in the community that have symmetry.

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Dear Second Graders,

We know you have learned a lot and are very smart. We need your help! We need to learn about symmetry. What can you teach us?

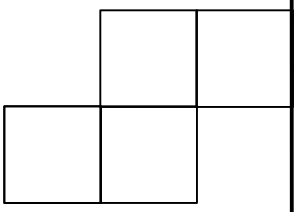
Your pals,
The First Graders

NAME_____ DATE_____

CUBE CONNECTION

Use your cubes to make each shape. Add cubes to make a new shape that shows symmetry. Now record the new shape by completing and coloring the designs below.

1.



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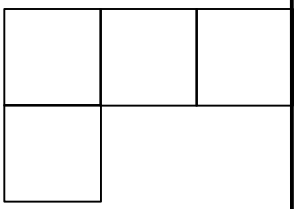

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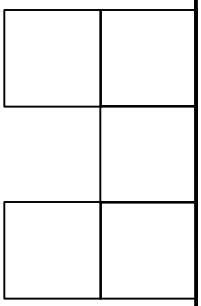
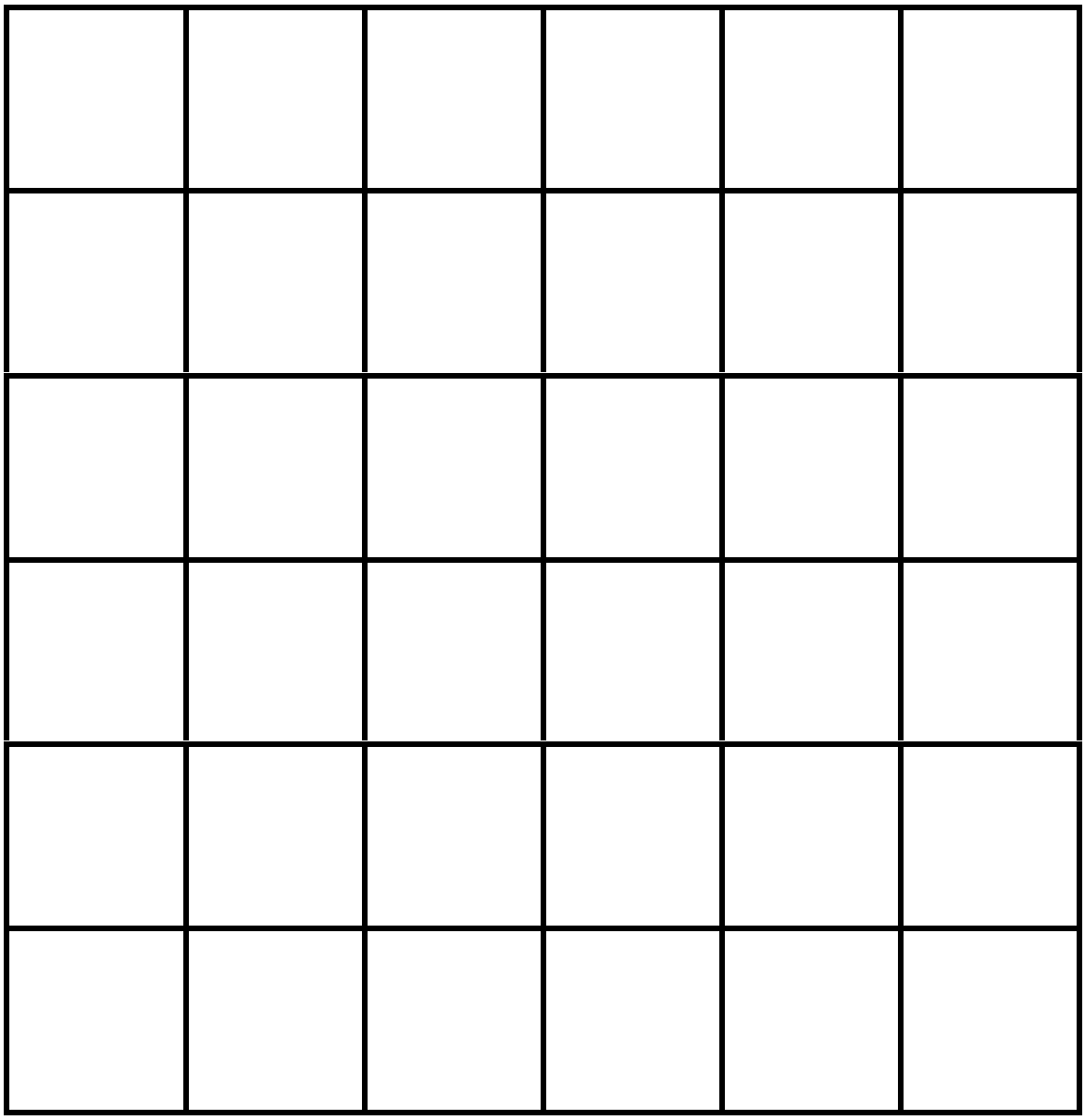


Student Resource Sheet #2

NAME_____DATE_____

BUILD YOUR OWN CUBE CONNECTION

Create your own cube designs that show symmetry. Color each design and draw a line to show the line of symmetry.



NAME_____DATE_____

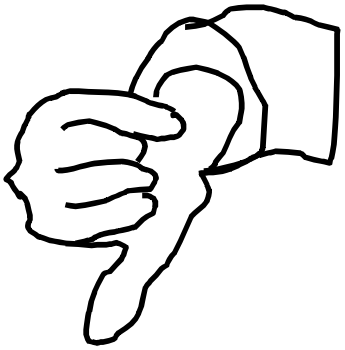
PATTERN PARTNERS

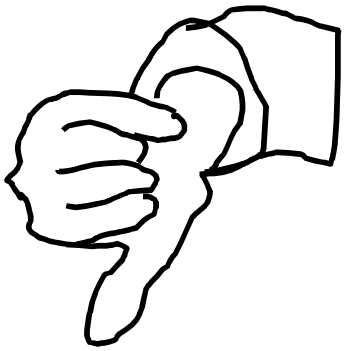
Get ready to be challenged!!! Use pattern blocks to make a design on <u>one side of the line of symmetry</u>. Have your partner make your design show symmetry by adding pattern blocks to the other side of the line. Trace and color the pattern blocks that you and your partner have created.

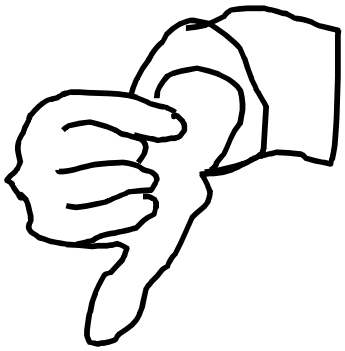
Student Resource Sheet #4

SECOND GRADERS TO THE RESCUE!

The first graders need our help to learn about symmetry. Let's make a book to help them learn about things that have symmetry and things that do not. Choose a card from the basket. If your card has  **created a pattern block design that shows symmetry or if your card has**  **created a pattern block design that does not show symmetry, then, write an explanation about your design to help the first graders understand it better. Do your best work so we do not let our friends down!**

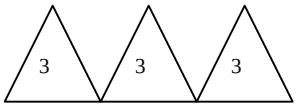




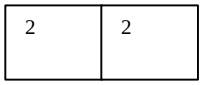


Student Resource Sheet # 5

BOOK PAGES SCORING RUBRIC

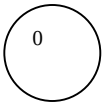


-My design matches my thumb card.
-My writing clearly explains if my design shows symmetry.
-My explanation contains at least 2 math words.



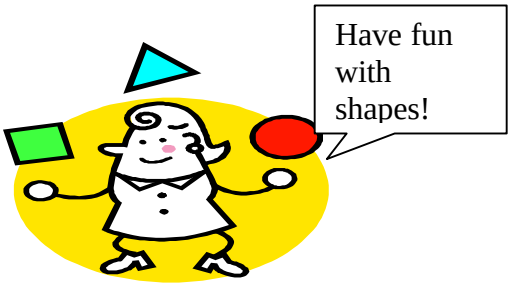
-My design matches my thumb card.
-My writing explains if my design shows symmetry.
-My explanation contains at least 1 math word.

-My design might match my thumb card.
-My writing tries to explain if my design shows symmetry.
-My explanation might use a math word.

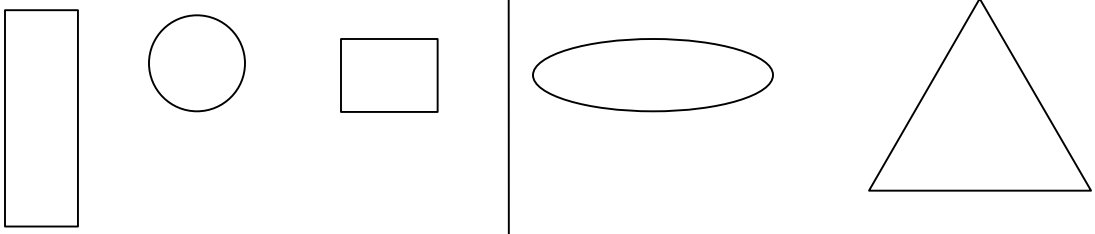


-My design does not match my thumb card.
- My writing does not explain if my design shows symmetry.
-My explanation does not use any math words.

My Design Practice Sheet



USE THIS SHEET TO CREATE YOUR DESIGN FOR OUR BOOK. HAVE YOUR PARTNER CHECK IT. THEN COPY IT ON TO DRAWING PAPER AND COLOR IT. HAVE FUN!!!!



*NAME*_____ *DATE*_____

Peer Response Form

Review your partner's work. Then respond by answering the following questions. Color  ***if you would answer "yes" to the question, and color***  ***if you would answer "no."***

1. Does the design match my partner's thumb card?

2. Does my partner's writing match the design?

3. Is my partner's writing easy to understand?

4. Did my partner use math words to describe the design?

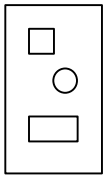
Does this design show symmetry?

Teacher Resource Sheet #3

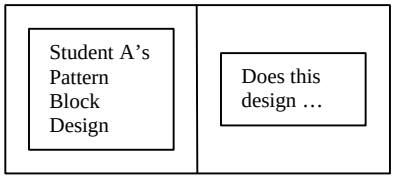
How To Put Together the Class Book

1. Create a title page for the book.
2. Put the book pages in the following order:
    a. Title page
    b. Student A's design
    c. Student A's explanation
    d. Student B's design
    e. Student B's explanation
    f. Student C's design
    g. Student C's explanation…
3. Glue the assembled pages on construction paper using both sides of the construction paper. For example, the title page will be glued on the front of the construction paper and Student A's design will be glued on the back of the construction paper. Then, Student A's explanation will be glued on the front of the second piece of construction paper and Student B's design will be glued on the back of the second piece of construction paper, and so on.
    a. Before gluing the explanations, be sure that they are folded so that the question *Does this design show symmetry?* is on the front and the student's explanation can be read when the front flap is opened. This page should be glued so that the open fold faces the bottom of the construction paper and the question about the design can be easily read.
    b. Be sure to keep the pages in order as you glue them!
4. Bind the book. If you do not have access to a bookbinder, punch 3 holes on the left hand side of the front of each page. Hook the pages together using three binder rings.
5. If the book has been constructed correctly, you should see the title page on the front. Then, when the book is opened, you should see Student A's design and explanation facing each other. This way, readers can look at the design, read the question about symmetry, and then open the flap to read the student's answer to the question. (See the picture below.)

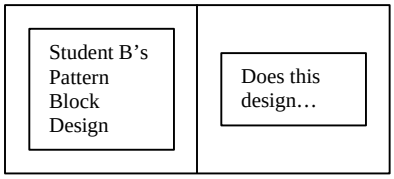
Title Page



Pages 1 and 2



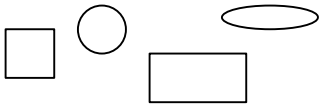
Pages 3 and 4



Note: The title page and page 1, and page 2 and page 3 are front to back.

Teacher Resource Sheet #4

Student Learning Checklist

Students' Names 	**Completes Cube Design**	**Identifies Shape Attributes**	**Completes Pattern Block Designs**	**Explains Solution Methods**

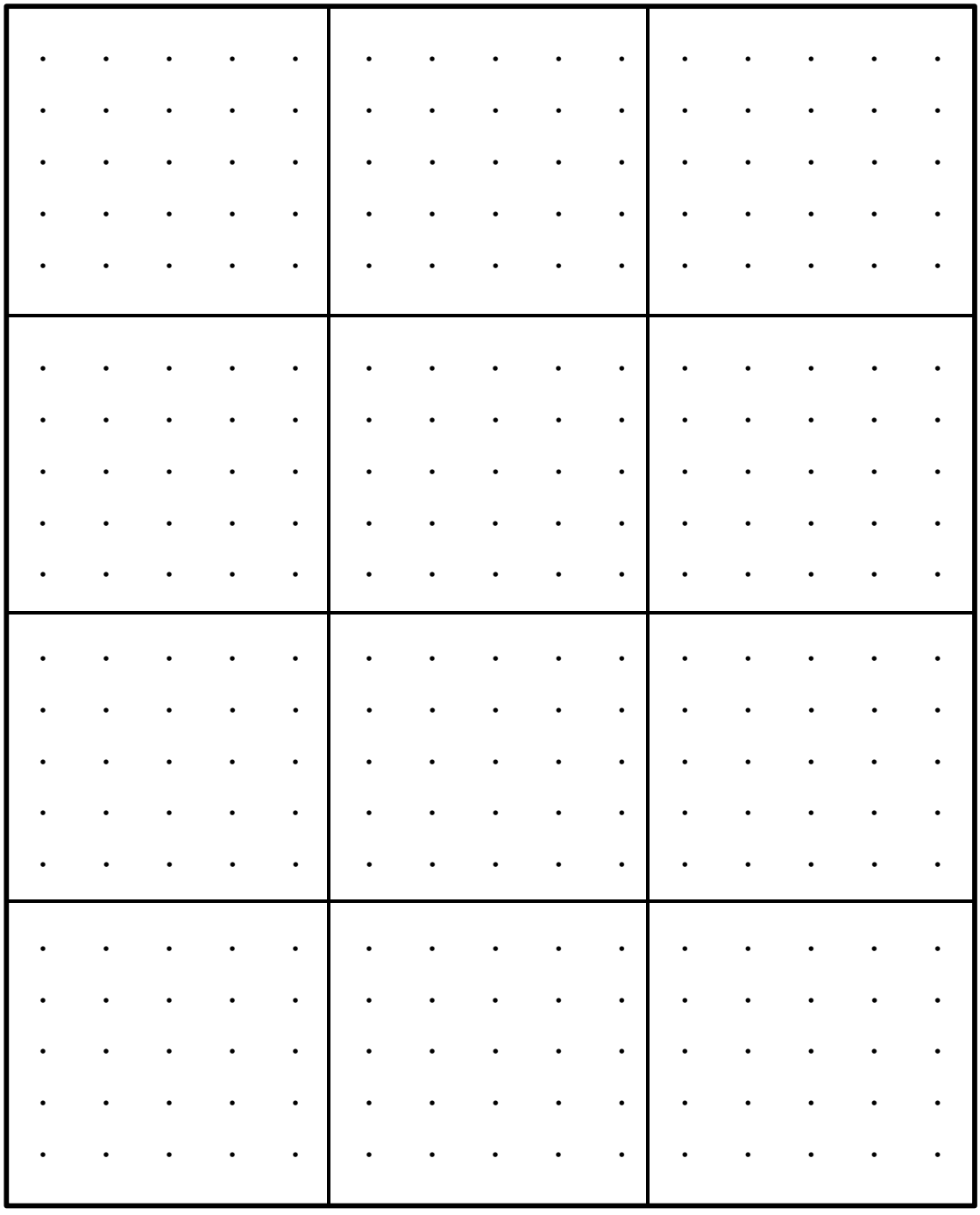
Use the following key to complete the checklist.

3: Student demonstrates complete understanding of symmetry & shapes
2: Student demonstrates some understanding of symmetry & shapes
1: Student demonstrates little understanding of symmetry & shapes
0: Student demonstrates no understanding of symmetry & shapes

Student Resource Sheet #10

Name _____ **Date** _____

Directions: Use rubber bands to make the letters of your name on a geoboard. Can you find a line of symmetry in the letters you make? If you can, draw the letter and its line of symmetry in one of the boxes below.



Student Resource Sheet #11

Name _____ ***Date*** _____

Symmetry Scavenger Hunt

Directions: Look around! What objects do you see that have symmetry? List and illustrate them below. (See if you can find at least 10!)